

Principles of Communications and Networks

Course Description:

The critical role of communications and networking in the defense community is widely recognized. The field is both broad and dynamic; while progress proceeds at a phenomenal pace, new issues and problems arise almost as fast. The underlying principles, however, change either slowly or not at all. A conceptual understanding of these principles can help those who work in all aspects of the field see the forest through the ever-changing trees. The course presents an introduction to the technical concepts that underlie the field: analog and digital communications, packet and circuit switching, voice and data networks, and the physics of radio, terrestrial, and satellite links.

OBJECTIVE

This course is intended to provide an overview of the key principles of communications and networking theory, using operational military communications systems to illustrate these principles. This is not an instruction course on how to design or operate specific systems, although it can help all technical professionals understand the nuances of their systems better. Rather, the objective is to provide a mixed technical and non-technical audience with a conceptually rigorous technical foundation. It deliberately covers a wide array of topics, based on the view that in the future all forms of military communications and networking will be tied more closely together, and thus a broader understanding will be of use to all. If successful, this course will further allow the graduates to converse more intelligently with subject-matter experts, and pave the way for further learning in more specific areas. While equations are kept to a minimum, the concepts presented are rigorous.

WHO SHOULD ATTEND

Those who have responsibilities for planning, acquiring, managing, monitoring, operating, and/or regulating communications or networking programs or systems in a military-oriented environment. The course is specifically intended for those who do not have an extensive formal background in the principles of communications but find themselves in a position where such a background would prove useful. It should also be of interest to engineers trained in other areas, and communications specialists seeking to review and expand their knowledge of the theory and practice of military communications.

COURSE OUTLINE

Day 1:

- Introduction to Electronic Communication
 - ~ The Significance of Human Communication
 - ~ Communication Systems
 - ~ Types of Electronic Communication
 - ~ Modulation and Multiplexing
 - ~ The Electronic Spectrum
 - ~ Bandwidth
 - ~ A Survey of Communication Applications
- Electronic Fundamentals for Communications
 - ~ Gain, Attenuation and Decibels
 - ~ Tuned Circuits
 - ~ Filters
 - ~ Fourier Theory
- Amplitude Modulation Fundamentals
 - ~ AM Concepts
 - ~ Modulation Index and Percentage of Modulation
 - ~ Sidebands and the Frequency Domain
 - ~ AM Power
 - ~ Single-Sideband (SSB) Modulation
 - ~ Classification of Radio Emissions
- Amplitude Modulator and Demodulator Circuits
 - ~ Basic Principles of Amplitude Modulation
 - ~ Amplitude Modulators
 - ~ Amplitude Demodulators
 - ~ Balanced Modulators
 - ~ SSB circuits
- Fundamentals of Frequency Modulation
 - ~ Basic Principles of Frequency Modulation
 - ~ Principles of Phase Modulation
 - ~ Modulation Index and Sidebands

- ~ Noise Suppression Effects of FM
- ~ Frequency Modulation vs Amplitude Modulation
- FM Circuits
 - ~ Frequency Modulators
 - ~ Phase Modulators
 - ~ Frequency Demodulators
- Digital Communication Techniques
 - ~ Digital Transmission of Data
 - ~ Parallel and Serial Transmission
 - ~ Data Conversion
 - ~ Pulse Modulation
 - ~ Digital Signal Processing

Day 2:

- Radio Transmitters
 - ~ Transmitter Fundamentals
 - ~ Carrier Generators
 - ~ Power Amplifiers
 - ~ Impedance-Matching Networks
 - ~ Typical Transmitter Circuits
- Communication Receivers
 - ~ Basic Principles of Signal Reproduction
 - ~ Superheterodyne Receivers
 - ~ Frequency Conversion
 - ~ Intermediate Frequency and Images
 - ~ Noise
 - ~ Typical Receiver Circuits
 - ~ Receivers and Transceivers
- Antennas and Wave Propagation
 - ~ Antenna Fundamentals
 - ~ Common Antenna Types
 - ~ Radio Wave Propagation
- Multiplexing and Demultiplexing
 - ~ Multiplexing Principles

- ~ Frequency Division Multiplexing
- ~ Time Division Multiplexing
- ~ Pulse Code Modulation
- ~ Duplexing
- Digital Data Transmission
 - ~ Digital Codes
 - ~ Principles of Digital Transmission
 - ~ Transmission Efficiency
 - ~ Modem Concepts and Methods
 - ~ Wideband Modulation
 - ~ Broadband Modem Techniques
 - ~ Error Detection and Correction
 - ~ Protocols
- Transmission Lines
 - ~ Transmission Line Basics
 - ~ Standing Waves
 - ~ Transmission Lines as Circuit Elements
 - ~ The Smith Chart
- Fundamentals of Networking, Local Area Networks and Ethernet
 - ~ Network Fundamentals
 - ~ LAN Hardware
 - ~ Ethernet LANs
 - ~ Advanced Ethernet

Day 3:

- Internet Technologies
 - ~ Internet Applications
 - ~ Internet Transmission Systems
 - ~ Storage-Area Networks (SANs)
 - ~ Internet Security
- Microwave and Millimeter Wave Communication
 - ~ Microwave Concepts
 - ~ Microwave Lines and Devices

- ~ Waveguides and Cavity Resonators
- ~ Microwave Semiconductor Diodes
- ~ Microwave Tubes
- ~ Microwave Antennas
- ~ Microwave and Millimeter Wave Applications
- Satellite Communication
 - ~ Satellite Orbits
 - ~ Satellite Communication Systems
 - ~ Satellite Subsystems
 - ~ Ground Stations
 - ~ Satellite Applications
 - ~ Global Navigation Satellite Systems
- Optical Communication
 - ~ Optical Principles
 - ~ Optical Communication Systems
 - ~ Fiber Optic Cables
 - ~ Optical Transmitters and Receivers
 - ~ Wavelength Division Multiplexing
 - ~ Passive Optical Networks
 - ~ 40/100Gbps Networks and Beyond
- Telecommunication Systems
 - ~ Telephones
 - ~ Telephone Systems
 - ~ Facsimile
 - ~ Internet Telephony
- Cell Phone Technologies
 - ~ Cellular Telephone Systems
 - ~ A Cellular Industry Overview
 - ~ 2G and 3G Digital Cell Phone Systems
 - ~ Long Term Evolution and 4G Cellular Systems
 - ~ 5G
 - ~ Base Stations and Small Cells
- Wireless Technologies
 - ~ Wireless LAN

- ~ PANs and Bluetooth
- ~ ZigBee and Mesh Wireless Networks
- ~ WiMAX and Wireless Metropolitan Area Networks
- ~ Infrared Wireless
- ~ Radio Frequency Identification (RFID) and Near Field Communications
- ~ Ultrawideband Wireless
- ~ Additional Wireless Applications

Day 4: Special Topics and Real World Application

- Spectrum Management
- Cell Phone and “Wireless” Technologies – use in CONUS or OCONUS
- Disaster Response
 - ~ FIRSTNET
 - ~ GETS and WPS
 - ~ Tropo
 - ~ Microwave
 - ~ Satcom
 - ~ HF (ALE, Scope Command, Regency Net)
- Airborne Comm Node
 - ~ Pseudo-satellite
 - ~ Aerostat
 - ~ High loiter UAV (Global Hawk)

LECTURER

Mr. Terry L. Stockholm

Terry Stockholm is a retired Air Force Lieutenant Colonel in Communications/Electronics and Information Technology Specialist with over 40 years of expertise in the C4ISR arena. He has served at FEMA as the Deputy Chief of IT operations and Chief of IT Disaster Operations nationwide. He was a contractor supporting DHS CIO during the standup of that department, division chief in the DHS Wireless Management Office, and after Hurricane Katrina was tapped by the Secretary of Homeland Security to evaluate and recommend changes to ensure all levels of responders can communicate during a similar disaster. He had multiple tours at national and

international spectrum management offices and deployed to Operations Desert Storm and Provide Comfort as a Senior Communications Planner. He has commanded a communications squadron and served a tour of duty on the National Airborne Operations Center supporting the President in nuclear command and control. He attended the Communications-Electronics Maintenance Officer School, Inter-Service Radio Frequency Management Course, U.S. Marine Corps Command and Control Systems Course and the Air War College. Terry holds a Master's in Systems Management from the University of Southern California and a Bachelor's in Chemistry and Biology from Wright State University.

HOURS OF COURSE: 8:00 AM to 4:30 PM. Sign in at the classroom commences at 7:30AM.

DRESS: Business Casual